

A NOTICE OF SOME OF THE RECENT WORK ON STOMACH DIGESTION.

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The study of physiology and the conduct of physiological experiment, while interesting in themselves and at times even fascinating, do not have the earnest sympathy of the practicing physician or surgeon for the reason that it is often a far call from normal physiology to the treatment of pathological conditions and the relation of one to the other is not always clear, and the full understanding of the one too often seems to shed little light on the other. Probably the great bulk of our therapeutic knowledge has come to us in an accidental way instead of by logical deductions from physiology on the one hand, or physiological action of drugs on the other. But we are coming to know more of the real secrets of physiology and some very happy applications have been made of our recent knowledge. The physiology of digestion has always had its devoted students, and in recent years no less skillful ones than in the years before; for by the labors of Pawlow in Russia, Bayliss and Starling in England, and Cannon and others in America, we have had real acquisitions to our knowledge of this important function. And inasmuch as all of us are disposed to neglect reading matter of this kind, I thought it might not be out of place to bring to our minds the gist of this work and see wherein it confirms established practice, and wherein it may offer suggestions of untried methods. I may say to start with that a good part of recent demonstrations serves to confirm clinical observations and preconceived notions and put them on an established basis of proof, and to that extent some of what I shall say may not appear at all new.

Physiologists are indebted to Pawlow for a very ingenious method of studying gastric secretion. He conceived the idea of diverting a portion of the stomach in such a way that

the diverticulum, while not communicating with the general cavity of the stomach, yet did not have its nerve or blood supply interfered with. By this device he could study gastric secretion under the influence of nearly all the stimuli that normally obtain in promoting that function. Pawlow proved that simple mechanical stimulation did not cause a secretion of gastric juice, but of an alkaline mucus—in effect a protective secretion. He also showed that alkaline solutions instead of promoting the flow of gastric juice—as had for so long been believed and taught—in reality retarded it. I think this finding rather confirms clinical conclusions in reference to the use of the alkalies as a promoter of stomach secretions. In old times, before stomach analyses were made, cases of high or low Hcl secretions were not properly differentiated, and alkalies being helpful in many cases of dyspepsia and promoting stomach comfort and appearing to promote stomach digestion, it was concluded they were in effect stimulants to the flow of gastric juice. Clinically, while alkalies give relief from the symptoms of hyperchlorhydria, I do not believe that the inhibiting effect Pawlow has found is a very great factor in effecting a cure. Their value is chiefly to give temporary comfort.

Pawlow's most effective work was to put on a rather solid basis of proof the various agencies that stimulate the flow of gastric juice. Under ordinary circumstances the secretion is largely a reflex act. Dogs were tested in various ways, and it was found that the sight of food or its smell were sufficient to cause a ready flow, but that the secretion was best stimulated through the sense of taste and as a reflex from mastication, especially of foods that have some pleasant savor. This reflex secretion which Pawlow called the appetite

juice could be kept up rather indefinitely if the hunger of the dog was not appeased. He effected this by dividing the esophagus in the neck and drawing the distal end of the upper portion to the surface so that when the dog swallowed the food it would not reach his stomach. It was also noted that the secretion of the gastric juice would often continue much longer than the actual presence of the stimulus. Hornburg made similar experiments on a boy who had an esophageal stricture with a gastric fistula. He and others observed, too, that the mastication of rubber or other indifferent substance failed to excite the secretion. In fact, throughout these experiments it was noted that the savory quality of foods had a large influence on the amount of secretion. Hunger was always found to play an important part.

From these findings we get several suggestions of value in feeding—but they are for the most part things that we have known—simply put on a more rational basis. In the first place in so-called weak stomachs frequent feeding of small amounts is justified by Pawlow's observation that in this way a large gross amount of secretion was secured in the 24 hours. Delicate stomachs and poor digestion for all time been treated this way, but on the ground, I think, that a fuller meal overtaxed the stomach physically, or transcended its digestive power. Now we are taught that while small feedings are better, because larger ones may be rejected or give pain—they are also better because they promote a more continued secretion.

Pawlow's experiments also confirm the accepted opinion that foods that have a good relish are most easily digested—though we know, too, that there are some very marked exceptions to this rule and its too close application in practice would lead us into some bad mistakes, for the more savory foods, and those we like best, are not necessarily the most digestible. In fact, a food such as meat, may have a good taste and tend to promote secre-

tion of hydrochloric acid, and yet its digestive requirements be much higher than milk, for instance—that to many people is insipid. But even the more bland foods such as milk and eggs can often be so prepared and served to a patient as to be appetizing, and thus offer a stimulus to stomach secretion. Apart from flavoring milk or cooking it with other food stuffs, it seems possible to promote its digestibility by such simple measures as sipping it or adding carbonated water.

Again, the value of thorough mastication receives fresh support from the proved fact that mastication is an active agent in causing the secretion of the appetite juice. The relish of foods and their thorough mastication are in this matter closely associated. Pawlow found, too, that the much declaimed against meat extracts have their use, though their calorie value is very small, in the fact that they are often relished when the more insipid things are not, and they may prepare the stomach for digestion of less appetizing dishes by their stimulating effect on the secretion. The service they perform is a genuine one, but should not let us forget that they are not of much value as foods. The suggestions furnished, namely, frequent small feedings, appetizing foods, and thorough mastication apply to a rather large number of cases that might rather be called feeding cases than stomach cases—for the reason that the deficient secretion and deficient appetite are a result of constitutional conditions such as cancer, nephritis, anemia, tuberculosis, neurasthenia, etc. I think it is rather rare that we find a deficient HCl secretion except as a part of a more widely extended pathology—or at least a functional disturbance that applies to the stomach only as a part of the system. But the hope for improvement of many of these patients, especially the tuberculous, anemic, and neurasthenic lies in our success in giving them nourishment. As to the use of bitters, Pawlow approves them, but holds

Beside alkalies, to which I have referred, Pawlow observed that fats inhibited very distinctly the secretion of Hcl, and when given with proteid were able to retard the digestion that they act only by improving the appetite.

of the latter. Clinically, the disturbing effect that certain fats, especially meat fats, have on stomach digestion, is one of our commonest observations. Milk fat, butter, cheese, etc., retard much less. What light is thrown on the treatment of an over secretion of Hcl-hyperchlorhydria? Understanding by this term, glass of milk or most any kind of food. They too, that there is not necessarily a high percentage of the acid, but that the essential factor is rather a hypersensitive mucous membrane and that the Hcl may be normal or even a little low. There are the patients that have pain when their stomach is empty—that get relief by water acting as a diluent, or by a have good digestion and a clean tongue. We give them alkalies that neutralize, and according to Pawlow inhibit to some extent. Or we say take a glass of milk or water when pain comes on or eat a little of most anything. All of these give relief temporarily. From what I have said, however, frequent eating and having a tendency to keep up the secretion of Hcl is contraindicated. Even water is said by Pawlow to act as a real stimulant to Hcl secretion. The definite indications growing out of the foregoing statements would, in hyperchlorhydria, be about as follows:

Two or three full meals instead of frequent meals; these meals to be of the less savory foods and to contain a good proportion of fats; as much insipid stuff as can be used. As to meats: Proteid takes up a large per cent. of Hcl, and is to that extent indicated, but as a well-known stimulant to secretion of Hcl. it is contraindicated. Theoretically, large amounts of good steak and roast would seem to be bad, though in practice they are recommended by many specialists. Condiments and relishes are not to be used. Sweets inhibit

Hcl. (Pawlow). This kind of diet would seem to meet the indications because it tends to rather lessen the amount of secretion, though clinicians vary very widely in their management of this functional disturbance. For the pain, alkalies to neutralize and water to dilute. Incidentally, many of these patients are to some extent neurotics and treatment of that feature is called for.

In addition to the gastric juice secreted in response to nervous stimuli there is a second secretion noted to occur when all connection of stomach with the central nervous system both by the pneumogastric and sympathetic is severed. It is proven, too, that this secretion is not due to mechanical irritation of food nor does it occur with a number of foods such as white of eggs, starch or bread, when they are introduced into the stomach, but does occur if they have been previously partly digested and then put into the stomach. But meat, meat extracts and milk and many other foods provoke this secretion when put into the stomach through a tube. It seems proven that this secretion does not occur as a purely local reflex by way of nerve plexuses in the gastric wall, and it is now accepted that meats, meat extracts and milk and other foods when first introduced, and others when partly digested contain certain chemical substances that act on the mucous membrane of the pyloric area and produce in this membrane a substance called gastric hormone or gastric secretin that circulates in the blood stream, and when it reaches the gastric glands provokes the secretion. The formation of this secretory stimulant seems to be limited to the pyloric area. A similar hormone is formed in the intestine, causing pancreatic and biliary secretion. I cannot say that the discovery of this stimulus to secretion has given any suggestions as to the treatment of stomach diseases. Physiologists, however, have become much interested in this essentially chemical relation of one organ or function to another and are inclined to

think that many of the so-called reflex interaction and co-relation of certain body functions will be ultimately explained on a chemical rather than a nervous basis.

But recent work on stomach physiology has not been limited to studies in its secretion. The muscular movements of the organ depending on its anatomy and the function of its different parts have come in for some interesting investigation. It has been known for a hundred years that the appearance of food in the pyloric area was different from that in the fundus, and that the intra-gastric pressure and muscular activity of the pylorus was greater than that of the fundus has also been known for a long time. Anatomically, there is known to be a difference not only in the glandular formation, but also in the musculature of these two portions of the organ—designating in a general way the right fourth as the pyloric portion, and the remainder the fundus. But it is only very recently that the functions of the two portions have begun to be really understood. Much of the credit for clearing up this field is due to Cannon and his associates at Harvard University. Cannon, in collaboration with physiologists and surgeons, has done a large amount of work on the gastric and intestinal functions and his findings are quoted freely all over the world.

The gastric movements have been studied by Cannon by feeding large amounts of bismuth with the food, and then studying the shadow with a fluoroscope. He finds that the fundus of the stomach is in effect an adaptive reservoir for the reception of food; that the muscular wall of this portion keeps up a constant tonic pressure upon the ingested food mass; that at times it squeezes a portion from the surface of the mass into the pyloric portion, but that so-called peristaltic waves are not observed; that when a fresh bolus of food is swallowed it seeks the center of the mass; that as a result of the comparatively undisturbed condition of the food after the end of the meal, and its not mixing with gastric

juice to any extent, starch digestion by virtue of the ptyalin of saliva keeps up for a long time. And here is furnished an additional demand for thorough mastication—namely, the better action of the ptyalin by its intimate mixing with the food.

In the pyloric portion, pyloric mill, it has been called—different doings are going on. Here it is we have vigorous peristaltic effort, by which food which has reached it is squeezed towards the pylorus only to find it closed and then to be squirted back towards the fundus and then picked up and churned back and forth. During this process the food is thoroughly mixed with the gastric juice; proteid digestion is inaugurated and carried to a greater or less extent. Finally the pylorus relaxes and the partly digested food is passed into the duodenum. The vigorous action of the pyloric portion can make up to some extent for incomplete mastication, and it is thought that the greater frequency of ulcer and cancer in this portion is the direct result of traumatism, which such vigorous work necessarily subjects it to. In man it appears that the passing forward and squirting backward of the food occurs in waves about 20 seconds apart, and these can be heard by auscultation. It may be that this can be utilized in differentiating the stomach retention of deficient peristalsis from that of pyloric obstruction—this, of course, before the vigorous waves of the latter condition are visible to the eye.

A natural query is, What is the stimulus on the stomach side to the relaxation of the pylorus? In all probability the pyloric closure and opening is the result of the complex stimuli arising both from the stomach and intestine. From the stomach side, Cannon teaches that it is the presence of free HCl that calls for pyloric relaxation; whereas the closure is prompt when acid material reaches the duodenum—a kind of protective measure to lessen the influx of acid chyme into the bowel. When the acid mass in the duodenum is neu-

tralized there is probably in the normal digestive tract no further interference with the opening if the free Hcl is present in the stomach. However, Cannon, Abbe and others have proven that after resection of the bowel the pylorus will not relax even under vigorous pyloric peristalsis for several hours; indeed, interestingly near the time Abbe sets for a rather strong agglutination of the stitched bowel.

By means of his bismuth shadows, Cannon was able to study with ease the intervals after ingestion of different types of food before they began to leave the stomach. His observations disclose just about what we should expect, bearing in mind the influences that provoke Hcl secretion and the varying Hcl needs of the various foods. Carbohydrate was found to begin to leave the stomach in ten minutes and to progress rapidly. This kind of food calls for very little Hcl, though it stimulates its flow to some extent, and as free Hcl is present from the beginning, such food rapidly passes to the duodenum, its normal place for digestion. It is said to be a custom with actors and public speakers to take chiefly carbohydrate before appearing on the stage. Nitrogenous food, especially some meats, stimulates Hcl freely, but it also re-

quires much Hcl for combination; for this reason the presence of free Hcl is delayed, and this kind of food leaves the stomach later than a meal of carbohydrate. The stomach is the natural place for meat digestion.

Fatty foods, inhibiting to a great extent the gastric secretion, there is required some time for the presence of free Hcl and fats were observed to leave the stomach very slowly.

These observations can certainly be utilized in practical feeding—especially in cases when it may be well to give the stomach muscles a rest, or at least not to over-burden it.

In conclusion, I may say that the old-time clinical observations that emotion retarded digestion, has had experimental confirmation. Cannon observed that a dog worried by a cat while eating gradually stopped secreting gastric juice.

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